JCARR
JOURNAL OF CLINICAL ADVANCES AND RESEARCH REVIEWS

Available online on http://www.jcarr.in/
Journal of Clinical Advances and Research Reviews (JCARR) April-June, 2025; 02(02); 10-13
ISSN: 3048-6556

Review

Importance of Green Principles in Drug Discovery: Updated Review

Shubham Aashiyan*[1], Km Preeti[2], Deepak Kushwaha[3], Neelam Singh[4], Vivek Kumar Kushwaha[5], Triloki Prasad[6]

[1,2] *Research Scholar, S.D. College of Pharmacy & Vocational Studies, Muzaffarnagar, (UP) Pin- 251001.*
[3,5] *Research Scholar, Swami Sahajanand College of Pharmacy, Harraiya Azamgarh U.P.*
[4]*Assistant Professor, Department of Pharmacy Meerut Institute of Technology, Meerut*
[6]*Assistant Professor, Kalka Institute for Research and Advanced Studies, Partapur bypass, Meerut*

Received: 15-03-2025 / **Revised:** 08-04-2025 / **Accepted:** 20-04-2025
Corresponding Author: Shubham Aashiyan
Email: shubhamaashiyan1999@gmail.com
Conflict of interest: Nil

Abstract:

Green chemistry provides a framework for chemists, pharmacists, medicinal chemists and chemical engineers to design processes, protocols and synthetic methodologies to make their contribution to the broad spectrum of global sustainability. Green synthetic conditions, especially catalysis, are the pillar of green chemistry. Green chemistry principles help synthetic chemists overcome the problems of conventional synthesis, such as slow reaction rates, unhealthy solvents and catalysts and the long duration of reaction completion time, and envision solutions by developing environmentally benign catalysts, green solvents, use of microwave and ultrasonic radiations, solvent free, grinding and chemo-mechanical approaches.

Keywords: Green chemistry, Environment, Green methods, Reduce waste**,** High yield**.**

Introduction:

In current situation, the implementation of green chemistry principle quite effective and necessary whole we synthesize so many products organic chemicals, and other product in demand. It focuses on the principles of environmental sustainability, resource efficiency, and human health protection [1-6]. Green chemistry also better know with sustainable chemistry. Making such striking ideas and implementing rules for betterment of environment and beneficial to human health along with efficient to commercial industry production in developing country. Recent trends of drug development sum-up their potential in drug therapy after their identification as hit molecules and its synthesis.

conventionally, organic synthesis based upon so much use of organic solvent, energy dependent reaction, which is more lethal to environment by produced so much waste organic material [2]. However implementation these principles always beneficial such a ways that minimizing solvent, producing good yields of compounds, minimizing waste. Applying sustainable rules its beneficiary in terms of drug development in search of drug molecules incorporating footprint for Pharmaceutical industry and drug developing business [7,8]. The premier edge of this principles to eliminate or reduce resource consumption In case doing this researcher allow to do high through output screening in order to identified selective molecules to be synthesize it may helps to reduce the extra unwanted burden during commercial or labs chemical synthesis .

Additionally, the use of greener solvents, such as water or bio-based alternatives, reduces the reliance on hazardous and environmentally damaging solvents, resulting in a decrease in both resource consumption

and waste generation. By adopting innovative techniques like flow chemistry, reactions can be performed continuously in a controlled flow system, minimizing the generation of unwanted byproducts and increasing process efficiency [9,10,11].

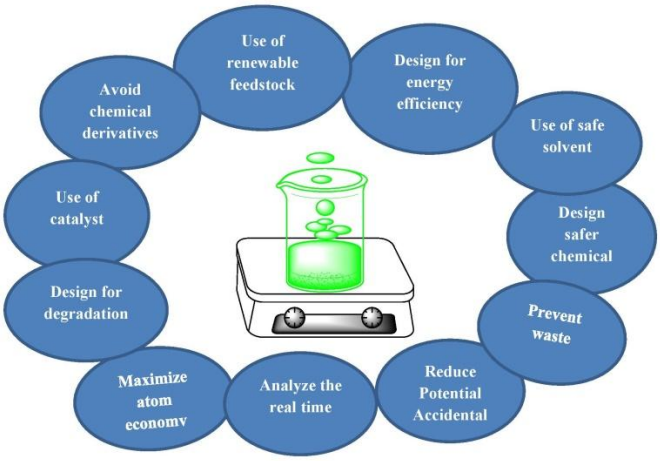

Figure:1 Green chemistry principles.

Apart from synthesis low byproduct burden it always help to restore valuable organic intermediates and catalyst as well resources management. All these might help to reduces the additional synthesis steps, leads to more convenient in terms of sustainability and more ecofriendly in process of Drug development.

In green chemistry edge that if bench chemist or investigator minimize the process like temperature, pressure as well as catalyst leads to lower impact on environment what in demands now in perspective of global warming. The use of milder reaction conditions also reduces the formation of hazardous byproducts, thereby enhancing the safety and sustainability of the drug development process. Challenges and Considerations of Green Chemistry the adoption and implementation of green chemistry principles in drug discovery and development present certain challenges that need to be addressed.

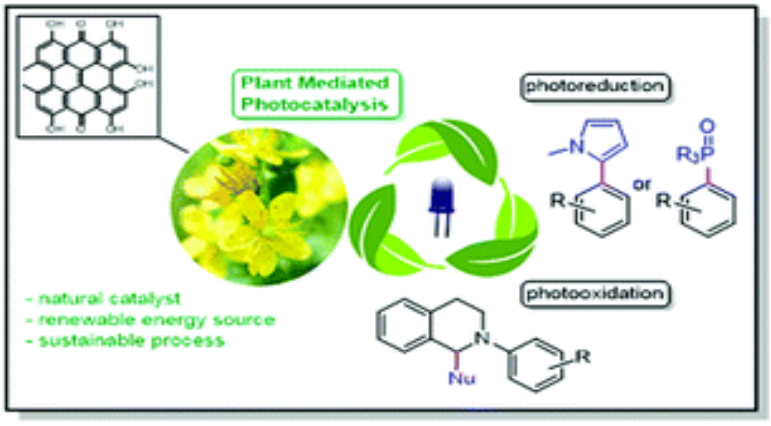

Figure:2 Photo redox catalysis in green chemistry organic synthesis.

One of major task to educate and aware researcher and industry domain people regarding implementation of green principles along its magical advantages over conventional synthesis of organic molecules or intermediates [12-16]. It requires a shift in mindset and a willingness to embrace new approaches and methodologies that prioritize sustainability. The availability and accessibility of greener alternatives, such as solvents, reagents, and catalysts, can pose a challenge. The pharmaceutical industry relies heavily on well-established and widely used chemicals and processes, making it challenging to transition to more sustainable options [9,17].

CONCLUSIONS

The implementation of green chemistry strategies in drug discovery and development holds great promise for promoting sustainability, minimizing environmental impact, and improving overall process efficiency. The utilization of computational methods and high-throughput screening techniques enables the prioritization of drug candidates, reducing the need for extensive synthesis and testing and conserving valuable resources. Designing molecules with reduced toxicity and improved biodegradability, the pharmaceutical industry can develop safer and more environmentally friendly drug candidates. Challenges related to the adoption and implementation of green chemistry principles, as well as the integration into existing drug development processes, must be addressed through education, collaboration, and regulatory support. Through overcoming these challenges and embracing green chemistry, the pharmaceutical industry can pave the way for a more sustainable and environmentally conscious approach to drug discovery and development, benefiting both human health and the planet.

References:

1. B. A. de Marco, B. S. Rechelo, E. G. Tótoli, A. C. Kogawa, and H. R. N. Salgado. (2019). "Evolution of green chemistry and its multi-dimensional impacts: A review". *Saudi Phar-maceutical Journal*. **27** (1): 1–8.
2. S. K. Singh, D. N. Rao, M. Agrawal, J. Pan-dey, and D. Naryan. (1991). "Air pollution tolerance index of plants". *Journal of Envi-ronmental Management*. **32** (1): 45–55, 1991
3. C. J. Li and B. M. Trost. (2008). "Green chemistry for chemical synthesis". *Proceed-ings of the National Academy of Sciences of the United States of America*. **105** (36): 13197–13202.
4. J. B. Manley, P. T. Anastas, and B. W. Cue. (2008). "Frontiers in Green Chemistry: meet-ing the grand challenges for sustainability in R&D and manufacturing". *Journal of Clean-er Production*. **16** (6): 743–750.
5. M. Poliakoff, J. M. Fitzpatrick, T. R. Farren, and P. T. Anastas. (2002). "Green chemistry: Science and politics of change". *Science*. **297** (5582): 807–810.
6. Nameroff TJ, Garant RJ, Albert MB. Adoption of green chemistry: an analysis based on US patents. Research Policy. 2004 Sep 1;33(6-7):959-74.7.
7. Wilson MP, Schwarzman MR. Toward a new US chemicals policy: rebuilding the foundation to advance new science, green chemistry, and environmental health. Environmental health perspectives. 2009 Aug;117(8):1202-9.
8. Anastas PT, Kirchhoff MM. Origins, current status, and future challenges of green chemistry. Accounts of chemical research. 2002 Sep 17;35(9):686-94.
9. Erythropel HC, Zimmerman JB, de Winter TM, Petitjean L, Melnikov F, Lam CH, Lounsbury AW, Mellor KE, Janković NZ, Tu Q, Pincus LN. The Green ChemisTREE: 20 years after taking
10. Green Chemistry Strategies in Drug Discovery and DevelopmentVol.30 No.18(2023):JPTCP(242-249)Page|249root with the 12 principles. Green chemistry. 2018;20(9):1929-61.
11. Cue BW, Zhang J. Green process chemistry in the pharmaceutical industry. Green Chemistry Letters and Reviews. 2009 Dec 1;2(4):193-211.11.Gillet S, Aguedo M, Petitjean L, Morais AR, da Costa Lopes AM, Łukasik RM, Anastas PT. Lignin transformations for high value applications: towards targeted modifications using green chemistry. Green Chemistry. 2017;19(18):4200-33.
12. Zimmerman JB, Anastas PT, Erythropel HC, Leitner W. Designing for a green chemistry future. Science. 2020 Jan 24;367(6476):397-400.
13. Boit TB, Bulger AS, Dander JE, Garg NK. Activation of C–O and C–N bonds using non-precious-metal catalysis. ACS catalysis. 2020 Sep 10;10(20):12109-26.
14. Ge S, Green RA, Hartwig JF. Controlling first-row catalysts: amination of aryl and heteroaryl chlorides and bromides with primary aliphatic amines catalyzed by a BINAP-ligated single-

component Ni (0) complex. Journal of the American Chemical Society. 2014 Jan 29;136(4):1617-27.

15. Semsarilar M, Abetz V. Polymerizations by RAFT: Developments of the Technique and Its Application in the Synthesis of Tailored (Co) polymers. Macromolecular Chemistry and Physics. 2021 Jan;222(1):2000311.
16. Iravani S, Korbekandi H, Mirmohammadi SV, Zolfaghari B. Synthesis of silver nanoparticles: chemical, physical and biological methods. Research in pharmaceutical sciences. 2014 Nov;9(6):385.
17. Koenig SG, Bee C, Borovika A, Briddell C, Colberg J, Humphrey GR, Kopach ME, Martinez I, Nambiar S, Plummer SV, Ribe SD. A green chemistry continuum for a robust and sustainable active pharmaceutical ingredient supply chain. ACS Sustainable Chemistry & Engineering. 2019 Sep 19;7(20):16937-51.

*****